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The Bidirectional Influence between Coherence Establishment and Pronoun Interpretation

Hannah Rohde & Andrew Kehler

Abstract

Problem: Previous work finds that pronoun interpretation in transfer-of-possession contexts is sensitive to coherence-driven biases, but that work does not address a mystery that has also been reported for such contexts: an asymmetry between pronoun production and interpretation.

Proposal: To explain the asymmetry, we introduce a Bayesian model of pronoun interpretation that distinguishes the primary factors (e.g., coherence relations) that generate expectations about who will be mentioned next ($p(\text{referent})$) from those factors (e.g., subjecthood) that primarily determine whether a speaker will choose to use a pronoun instead of a name ($p(\text{pronoun} | \text{referent})$). We predict more subject-biased coherence relations than non-subject-biased relations in a pronoun-prompt story-continuation condition.

Results: We find that the rate at which a pronoun is interpreted to refer to the subject reflects the likelihood that the subject referent will be mentioned again (regardless of referring expression) and the likelihood that a speaker will use a pronoun. Crucially, we find that, in contexts with an ambiguous pronoun prompt, the mere presence of a pronoun, even if its referent is ambiguous, can change the distribution of coherence relations.

1. Goals

- Distinguish factors that influence comprehenders' expectations for next mention from those that influence speakers' choice of referring expression
- Test whether ambiguous pronouns influence expectations about discourse direction given a production bias linking pronouns and subjects

2. Previous work: pronoun interpretation

Transfer of possession contexts

(1) John_{SOURCE} passed the comic to Bill_{GOAL}. He _____.

Stevenson, Crawley, & Kleinman (1994): interpretation biases compete

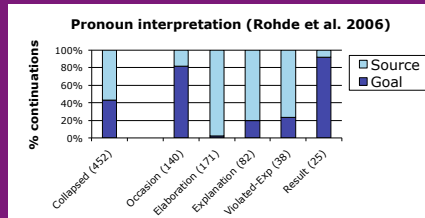
- Thematic role bias (favoring Goal over Source)
- Subject assignment bias (favoring subject Source)

RESULT: participants interpret pronoun 50/50 to Source/Goal

Rohde, Kehler, & Elman (2006): interpretation reflects discourse biases

- Biases about where discourse is going (coherence relations)
- Biases about who is likely to be mentioned next (given discourse direction)

RESULT: interpretation depends on operative coherence relation



→ This result does not cast any light on the interpretation/production asymmetry.

3. Interpretation/Production asymmetry

Prompt/no-prompt conditions reveal apparent asymmetry (Stevenson et al. 1994; Arnold 2001)

(2) a. John passed the comic to Bill. He _____
b. John passed the comic to Bill. _____

Choice of next mention

- (2a) – pronoun interpretation 50/50 to Source/Goal
- (2b) – strong bias to refer to Goal as next mention

Choice of referring expression

- (2b) – pronoun production biased to subject Source
- (2b) – name production biased to non-subject Goal

Stevenson et al.: asymmetry provides evidence for subject assignment bias that competes with thematic role bias

→ Claim for 2 biases: an expectation for a subsequent mention of a referent, $p(\text{referent})$, and an expectation about the form of referring expression that the speaker would use to mention that referent, $p(\text{pronoun} | \text{referent})$.

4. Proposal: Bayesian model

$$p(\text{Goal}) = .856$$

(2b) as per Arnold

$$p(\text{Goal} | \text{pronoun}) = \frac{p(\text{pronoun} | \text{Goal}) * p(\text{Goal})}{p(\text{pronoun})}$$

(2b) as per Arnold

$$\frac{30 * 149}{149 * 174 + 49 * 174} = .612$$

Claims:

- $p(\text{Goal})$ reflects coherence biases (e.g. Occasions biased to Goal)
 - $p(\text{pronoun} | \text{Goal})$ reflects production preferences (i.e. speakers are more likely to pronominalize a reference to subject)
- Prediction: presence of a pronoun in (2a) will yield more subject Source interpretations and more Source-biased coherence relations

$$p(\text{CR}) = p(\text{CR} | \text{Goal}) * p(\text{Goal}) + p(\text{CR} | \text{Source}) * p(\text{Source})$$

5. Story continuation experiment

Task: participants instructed to imagine a natural continuation to a context sentence and prompt

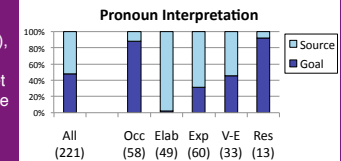
Materials: pronoun prompt (2a) and bare prompt (2b)

Judges: annotation for next mention, intended pronoun interpretation, and coherence relation

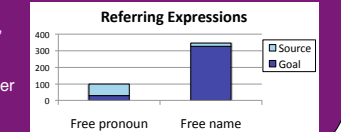
6. Coreference results

Replication:

- **Pronoun interpretation:** for (2a), pronoun is interpreted 50/50 to Source/Goal (as per Stevenson et al.), but biases differ by coherence relation (as per Rohde et al.)



- **Referring expressions:** for (2b), pronouns are used to refer to the Source, while names refer overwhelmingly to the Goal (as per Stevenson et al., and Arnold)

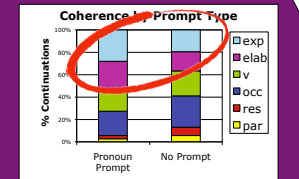


7. Coherence results

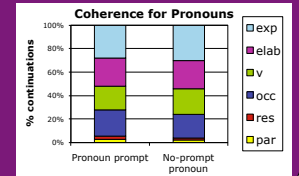
Prompt type: as predicted, the pronoun prompt (2a) yielded more Source-biased relations than did the bare prompt (2b)

Exp: $F_1(1,51)=13.373$, $p<0.001$ *
 $F_2(1,20)=15.218$, $p<0.001$ *

Elab: $F_1(1,51)=2.772$, $p<0.102$
 $F_2(1,20)=5.395$, $p<0.031$ *



Source-biased pronouns: as predicted, there was no significant difference in the distribution of coherence relations between (2a) and (2b) when only continuations with pronouns are considered



8. Summary: bidirectional influences

- Coherence influences pronoun interpretation:** choice of next mention, $p(\text{Goal})$, reflects coherence-driven biases
- Pronoun interpretation influences coherence establishment:** knowing that pronouns are more likely to be produced for a subject referent shifts coherence distribution, even when pronoun is ambiguous

References

Arnold, J. E. (2001). The effects of thematic roles on pronoun use and frequency of reference. *Discourse Processes* 31:2-137-162.
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